Teuvo AHTI*: **The lichen genus *Cladonia* in Mongolia****

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Up to the 1960's the lichen flora of Mongolia (=Mongolian People's Republic, formerly Outer Mongolia) was almost unknown. However, although its climate is notoriously highly arid and continental, it possesses a surprisingly rich lichen flora. Thanks to the recent works on Mongolian lichens, mainly by German and Soviet lichenologists, about 450 species have been recorded from the country (Schubert & Klement, 1971; Golubkova, 1971; Golubkova & Tsogt, 1974a, 1974b). The present state of knowledge is, however, quite superficial, since a number of records appear to be doubtful, being based on erroneous identifications. There are numerous taxonomically critical or very little known species, especially those described from the adjacent parts of China (Kansu, Inner Mongolian Autonomous Region and Sinkiang) by Magnusson (1940, 1944). The studies by myself and some other authors (cf. Weber, 1968) unfortunately seem to indicate that many of the new taxa in those two papers shall be reduced to synonymy in course of time and all of the identifications need checking.

The present synopsis is primarily based on my collections and field records made in Mongolia in 1970 and 1972. Financial support from the Academy of Finland and the Emil Aaltonen Foundation is gratefully acknowledged. For other assistance I wish to thank the Mongolian State University, Prof. Tycho Norlindh, Mr. J. Bitsch, Dr. T. Zhamsran, Mr. U. Tzogt, and Dr. N. Uldziykhutag, as well as the curators of the herbaria consulted.

The species of the genus *Cladonia* are not particularly common in Mongolia, and in large parts of the country they are totally absent. However, it is of interest to note the distribution of the species along the great climatic gradient in Mongolia, from the boreal forest (taiga) in the north through the forest-steppe, steppe and semidesert to the bleak Gobi Desert in the south (cf. Grubov, 1959; Yunatov, 1974: Fig. 3). I have no experience

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** Contribution in honor of the late Dr. Yasuhiko Asahina of the "alpine" areas of Mongolia.

1) Boreal forest. The South Siberian mountain taiga or oroboreal coniferous forest, mainly dominated by *Larix sibirica*, extends to northern Mongolia along most of the Soviet boundary. With this forest most of the *Cladonia* species of the continental Siberian forests are expected to occur in Mongolia. In fact, out of the 25 species of *Cladonia* that Rassadina (1936) reported from the Lake Baykal region 20 are already known from Mongolia. The characteristic species of this element include *C. stellaris*, *C. amaurocraea* and *C. bacillaris*. The annual precipitation in the area ranges from 300 to 500 mm (Gungaadash, 1969).

2) Forest-steppe. In this fairly arid "zone" of alternating larch forests and steppes (actually mountain forest-steppe according to Lavrenko, 1970) the number of *Cladonia* species is still considerable. Byazrov (1974) recorded 11 species in his phytosociological study of lichen synusiae in the larch forests of the Hangay Range; eight species were found on soil and six species at bases of *Larix* or *Pinus cembra* ssp. *sibirica*. The most frequent species include *C. coniocraea*, *C. fimbriata*, *C. crispata* and *C. digitata*. In the steppe openings it is particularly *C. pocillum* that may be locally abundant on soil or in rock crevices. Though most of the boreal forest *Cladoniae* may occur in the forest-steppe woods, the frequency of the representatives of the subg. Cladina, for example, is apparently much reduced.

3) Steppe. Although saxicolous lichens are abundant in the true steppes of Mongolia, there are very few *Cladoniae*. *C. pocillum*, *C. pyxidata* and *C. chlorophaea* may be found on rocks, particularly in sheltered situations. On steppe soil, particularly in the northern short-grass steppes dominated by *Koeleria gracilis* and *Poa attenuata*, *C. synphycarpa* may be abundant, and also *C. pocillum* and *C. polycarpoides* have been observed in such places. But in general *Cladoniae* are completely absent from the steppes, particularly in regions with an annual rainfall below 150 mm.

4) Semidesert (or desert-steppe of Yunatov, 1974). No *Cladonia* is present. The records from the Gobi Altai Range and elsewhere all seem to come from isolated outliers of mountain steppes in the higher mountains, especially from their northern slopes. Golubkova & Tsogt (1974b) did not report any *Cladonia* from the Orok Nur semidesert region, either.

5) Desert. No *Cladonia* present. All lichens are very scarce in the true

Gobi Desert (Golubkova & Tsogt, 1974a), especially in areas with an annual rainfall below 100 mm.

In general the Mongolian *Cladonia* species belong to the widespread, boreal to temperate, circumpolar element. Only *C. kanewskii* and *C. arbuscula* subsp. *beringiana* represent the amphi-Beringian distribution group. No special Central Asian element is definitely known in *Cladonia*.

Collecting localities

My collecting localities of *Cladonia* in Mongolia are briefly listed below (see Fig. 1).

Central (= Töv) Aimak:

A=Lün Somon: c. 15 km (Aa) or 20 km (Ab) E of Lün, steppe, 1970.

B=Bayantsogt Somon: c. 39 km W of Ulan Bator, steppe, 1970.

C=Altanbulag Somon: c. 50 km SE of Ulan Bator, Shar Hooloy, c. 1550 m, steppe, 1972.

D=Bayandzurh Somon: Hentiy Range, S of Terelj Sanatorium, forest-steppe, 1970.

Ulan Bator City:

E=Mt. Bogd Uul, c. 1450-1800 m, oroboreal *Picea-Larix* forest and forest-steppe, 1972.

F=c. 3 km NE of the centre, c. 1400 m, steppe. 1972.

Övörhangay Aimak:

G=Hujirt Somon: Hangay Range, c. 32 km W of Hujirt, *Larix sibirica* woodland (forest-steppe) on steep bluff by Orhon River, c. 1700 m (Ga=c.

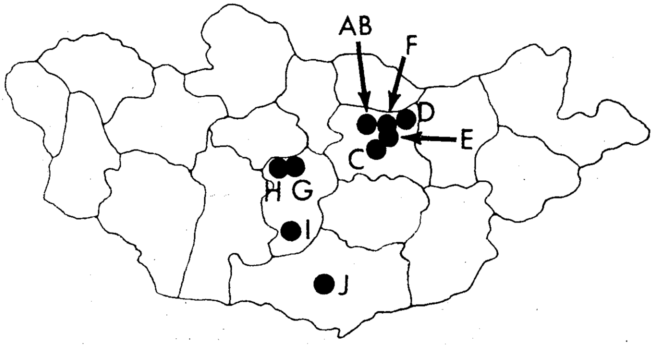

Fig. 1. The author's collecting localities of *Cladonia* in Mongolia. Symbols A-J are explained in the text.

33 km W of Hujirt, lava rocks), 1970.

H=Bat-Öldziy Somon: Hangay Range, by Ulaan Tsutgalaan Falls in Orhon River, c. 80 km WSW of Hujirt, c. 1850-1900 m, forest-steppe, 1970.

I=Bogd Somon: Baga Bogd Range, Hanhyn Gorge, Hüren hadny rashaan, 2300-2700 m, outlier of mountain steppe, 1972.

South Gobi (Ömnögovi) Aimak:

J=Dalandzadgad Somon: Gurvan Sayhan Range, Dzüün Sayhan Mts., Yolyn Canyon, 2150-2300 m, semidesert (to mountain steppe), 1972.

My collections are preserved in Helsinki (H), with a good duplicate set in Ulan Bator (UBU); some duplicates are also in Stockholm (S), Leningrad (LE) and elsewhere.

List of species

Less than 32 species of *Cladonia* are reported from Mongolia. Some records are doubtful and I have personally seen specimens of only 23 species. The literature records verified by me from herbarium specimens in Gatersleben (GAT), Halle (HAL), Leningrad (LE), Stockholm (S) or Ulan Bator (UBU) have been indicated with a note of exclamation (!). My collection numbers are cited after the symbols (capital letters) of the collecting localities, except in case of sight records. The Arab numerals refer to the list of references as follows.

1=Ahti, 1961; 2=Elenkin, 1902; 3=Golubkova, 1971; 4=Hanelt and Davažamc, 1965; 5=Klement, 1966; 6=Schubert et al., 1969; 7=Schubert & Klement, 1971; 8=Vězda, 1965; 9=Byazrov, 1974; 10=Magnusson, 1940.

The records are listed according to the *aimaks* (aymags) on provinces of Mongolia (no. 10 is in China!). The English orthography of transliteration generally follows the gazetteer "Mongolia, official standard names" (1970).

Cladonia acuminata (Ach.) Norrl. var. *norrlinii* (Vain.) Magn. (*C. norrlinii* Vain.). Övörhangay: G (26712). Ulan Bator: E (29181). On bluff by river in forset-steppe and in open scree in forest. The specimens contain atranorin and (probably) psoromic acid (TLC). New to Mongolia, since the specimen (HAL) reported by Schubert & Klement (1971) belongs to *C. symphycarpa* and *C. pocillum*.

C. amaurocraea (Flörke) Schaer. Uvs: 8. Dzavhan: 3. Hövsgöl: 3. Arhangay: 5!, 7, 9. Central: 3, D. Ulan Bator: E (29138). On rocks or soil in forest regions, locally very abundant.

C. arbuscula (Wallr.) Rabenh. subsp. *beringiana* Ahti (*C. sylvatica* auct., *Cladina beringiana* (Ahti) Trass). Hövsgöl: 2 (?, as *C. sylvatica* s. lat.), 3. Selenge: 1! (not on the Mongolian side?). Central: 1! Ulan Bator: E (29139, 29180, 29190a). In wooded regions or above them. At Ulan Bator abundant on screes surrounded by spruce or larch woods (alt. 1600-1900 m, in the lower to middle oroboreal zones).

C. bacillaris (Ach.) Nyl. Uvs: 7. Arhangay: 9. Central: D (26700). On logs and stumps of *Larix* in woods. Contains barbatic acid (TLC).

[*C. brevis* (Sandst.) Sandst. See under *C. cariosa*]

C. cariosa (Ach.) Spreng. Ulan Bator: 4. Gobi Altai: 7. [Sinkiang: 10!, as *C. brevis*].

C. cenotea (Ach.) Schaer. Arhangay: 7, 9. Selenge: 3. Central: D (26651). On rotten wood or humous soil in woods.

[*C. cervicornis* (Ach.) Flörke. See under *C. pocillum* and *C. symphycarpa*]

C. chlorophaea (Sommerf.) Spreng. Uvs: 7, 8. Arhangay: 7!, 9. Central: D (26677). Ulan Bator: E. Gobi Altai: 7. On rotten wood or soil, mainly in woods. See also *C. pyxidata*.

C. coniocraea (Flörke) Spreng. Uvs: 7. Arhangay: 7!, 9. Central: D (26643, 26692). Ulan Bator: 7, E. Gobi Altai: 7. [Sinkiang: 10!]. On rotten wood, only in woods. Also the specimen (HAL) of *C. ochrochlora* reported from Uvs (7) belongs here. Several additional specimens were seen in UBU (coll. N. Uldziykhutag).

C. cornuta (L.) Hoffm. Uvs: 7. Arhangay: 7. Only in woods.

C. crispata (Ach.) Flot. Arhangay: 9. In addition, among *C. rangiferina* and *C. amaurocraea* in the specimen Schmiedeknecht 2440 (GAT) I detected an unknown taxon, which resembles *C. crispata* but reacts PD+red (contains fumarprotocetraric acid?) and has no cup-formation in podetia. The specimen is sparse.

C. digitata (L.) Hoffm. Uvs: 7. Arhangay: 9. Central: D. On rotten wood in forest.

C. deformis (L.) Hoffm. em. Asah. Central: D. On soil in second-growth birch woods. New to Mongolia (the specimen unfortunately lost).

C. fimbriata (L.) Fr. Uvs: 7. Arhangay: 7!, 9. Central: D (26595). Ulan Bator: E. Hentiy: 3. [Sinkiang: 10!, as *C. chlorophaea* var. *pachyphyllina*]. On mossy soil, rotten wood and tree bases in forests.

C. furcata (Huds.) Schrad. (incl. *C. pinnata* (Flörke) Anders). Arhangay: 7! (as *C. pinnata*). Central: D (26653). On soil in woods.

C. gracilis (L.) Willd. Central: 6!, D (26654). Ulan Bator: E (29188, 29193). On boulders and logs in woods. The specimens represent a robust and squamulose variant of var. *gracilis* (no atranorin found with TLC), similar to that found, e.g., in the mountains of Turkestan (H) and in the Alps in Europe. The common boreal var. *dilatata* auct. is also expected to occur in northern Mongolia, since it is common in the Lake Baykal region.

C. grayi Sandst. Bulgan: 3. In forest.

C. kanewskii Oxn. Central: Upper course of Tuul Gol, 1900 m, 1974, Golubkova & Tsogt 182 (H, LE). New to Mongolia. An interesting finding of this essentially North Pacific species, which has been known from only one isolated inland locality (the type locality!) from the Lake Baykal area (Ahti, 1973).

C. merochlorophaea Asah. Ulan Bator: E (29128a). At base of *Larix sibirica*. Represents the merochlorophaeic acid strain (TLC). New to Mongolia.

C. mitis Sandst. Ulan Bator: E (29185). On rocky slope in woods, sparse among abundant *C. arbuscula* subsp. *beringiana*. New to Mongolia.

C. ochrochlora Flörke Arhangay: 9. Very doubtful, since an oceanic taxon. See also *C. coniocraea*.

C. pityrea Flörke Arhangay: 9. Another very doubtful record of an oceanic and southern species.

C. pleurota (Flörke) Schaer. Ulan Bator: E (29128). At base of *Larix sibirica*. Contains zeorin (TLC). New to Mongolia.

C. pocillum (Ach.) O.-J. Rich. Uvs: 8. Central: 6! (as *C. cervicornis*), D (26642, 26667a). Ulan Bator: E (29073), F (29045, 29053). Hovd: 7! (as *C. acuminata*). Gobi Altai: 7. Övörhangay: G (26713), I (29250a). South Gobi: G (29373). [Sinkiang: 10!]. This taxonomically somewhat critical, calciphilous species may be actually the most frequent *Cladonia* in Mongolia, ranging from the high mountains (3100 m in Altai; Vězda, 1965) and forests to the steppes. It grows on soil and rocks, and was once collected on stump of *Larix*. Some of the Mongolian records of *C. pyxidata*, and perhaps other species as well, may belong to *C. pocillum*, since the species is not always easy to recognize.

C. polycarpoides Nyl. (*C. subcariosa* auct.). Central: C (29471). Locally abundant on soil in *Koeleria-Festuca* steppe with *Parmelia* (Xanthoparmelia) *camtschadalis* (= *P. vagans* auct.). Although the podetia are very poorly developed in the material, there is no other species known with the same chemical contents: norstictic acid (no atranorin) and an unknown substance (TLC; cf. Culberson, 1969). New to Mongolia.

C. pyxidata (L.) Hoffm. Uvs: 7. Arhangay: 5, 7, 9. Central: 6, D (26616, 26656). Hovd: 7. Gobi Altai: 7. Bayanhongor: 7. Övörhangay: 3, Ga (26738), H (26710, 26711). On rocks, soil, wood and tree bases in forest, forest-steppe and even steppe. Taxonomically difficult variants are common, many approaching *C. chlorophaea* or *C. pocillum*. The complex is not fully clarified.

C. rangiferina (L.) Wigg. (*Cladina rangiferina* (L.) Nyl.). Hövsgöl: 2. Arhangay: 5! Central: 1! Ulan Bator: E (29141). On ground, only in forests. At Ulan Bator very sparse in extensive stands of *C. arbuscula* and *C. stellaris*.

C. squamosa (Scop.) Hoffm. Uvs: 7! In forest.

C. stellaris (Opiz) Pouz. & Vězda (*Cladina alpestris* (L.) Harm.). Hövsgöl: 2, 3. Selenge: 3. Central: 1! Ulan Bator: E (29192). Hentiy: 1!, 3. Aimak unknown: 'Baculej River' (1!). In woods, at Ulan Bator abundant on a scree at 1800 m (middle oroboreal zone).

C. subulata (L.) Wigg. Uvs: 7. Ulan Bator: E. Gobi Altai: 7. In forest.

C. symphycarpa (Ach.) Fr., s. lat. (incl. *C. dahliana* Krist.) Uvs: 7. Arhangay: 7. Central: 6! (as *C. cervicornis*), D (26667), Aa (26870), Ab (26714), B (26584), C (29471). Ulan Bator: 7. Övörhangay: I (29250). Hovd: 7! (as *C. acuminata*). South Gobi: J (29373a, 29389). [Sinkiang: 10!, as *C. pyxidata* var *pocillum*]. This is another calciphilous species which is common and widespread in Mongolia. It is often the only *Cladonia* in steppes and may locally form extensive but generally very inconspicuous covers. It is also found on mossy rocks. Most of the specimens proved to contain psoromic acid besides atranorin (TLC). Such a strain is not usually reported in literature, but recently Kristinsson (1974) described a *C. dahliana*, containing psoromic acid, from Iceland, Greenland and Arctic Canada. The Mongolian lichen seems to be the same, but I am unable to see morphological differences between "*C. dahliana*" and *C. symphycarpa* contrary to the report by Kristinsson. Neither the Mongolian nor the Arctic material is known to bear podetia. However, Harris (1975) reported a psoromic acid strain of

C. symphycarpa from Michigan, which has podetia. In addition, in my material no. 26667 represents the fumarprotocetraric acid-atranorin strain.

C. turgida (Ehrh.) Hoffm. Selenge: 3. In forest.

C. uncialis (L.) Wigg. Arhangay: 7. In forest.

Summary Thirty two species of *Cladonia* are reported from Mongolia. Seven species are new to the country, viz. *C. acuminata* var. *norrlinii*, *C. deformis*, *C. kanewskii*, *C. merochlorophaea*, *C. mitis*, *C. pleurota*, and *C. polycarpoides*. *C. symphycarpa* is mainly represented by a psoromic acid strain and a new PD+red strain is reported under *C. crispata*.

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蒙古人民共和国（旧外蒙古）の地衣類については1960年代まで殆んど知られていなかったが，最近のドイツおよびソ聯の地衣学者による研究で，現在約450種が知られている。しかし，これらのなかには疑わしいものがかなりあって再検討が必要である。本論文では主として著者自身の採集品をもとにしてハナゴケ属の32種を報告した。これらのうち，*C. acuminata* var. *norrlinii*, *C. deformis*, *C. kanewskii*, *C. merochlorophaea*, *C. mitis*, *C. pleurota*, *C. polycarpoides*, の7種は蒙古に新記録である。また，*C. symphycarpa* はプソローム酸を含むものが主であり，*C. crispata* には PD+赤色の系統のものがあることを報告した。